AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF NOBLE COUNTY, INDIANA

DECEMBER 1962

NO. 27

by

P.T. YEH

Joint Highway Research Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA

Final Report

AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF
NOBLE COUNTY, INDIANA

TO: K. B. Woods, Director
Joint Highway Research Project

December 14, 1962

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

File: 1-5-2-36
Project: C-36-51B

The attached report entitled "Airphoto Interpretation of Engineering Soils of Noble County, Indiana", completes a portion of the project concerned with engineering soils mapping from aerial photographs. The report was prepared by P. T. Yeh, Research Engineer, Joint Highway Research Project.

The soils mapping of Noble County was done primarily by airphoto interpretation. To increase the value of the county soil maps, the major soil types were sampled and tests were conducted in the soils laboratory. The soil tests performed include grain-size analysis, liquid limit, plastic limit, standard AASHO compaction and the California Bearing ratio test. The soils were classified using both the unified soil classification system and the American Association of State Highway Officials System. Generalized soil profiles of the major soil groups were included on the soil map. An ozalid print of the engineering soils map and a summary table of the engineering test data are included in the report.

Respectfully submitted,

H. L. Michael

H. L. Michael
Associate Director

HLM/lko

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Research Engineer

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Purdue University
Lafayette, Indiana

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INTRODUCTION

The engineering soils map of Noble County, Indiana, which accompanies this report, was compiled from 7" x 9" aerial photographs having an approximate scale of 1:20,000. All of the airphotos were taken in October 1938 in connection with the United States Department of Agriculture program and were purchased from that agency.

The recessional moraines of the county had been mapped by Katsuyoshi Nishimura in his master's thesis entitled "Airphoto Pattern Study of the Erie Lobe Recessional Moraines in Indiana" (1). Revisions and details were added, and the remaining area of the county was mapped to complete the engineering soils map.

Photo interpretation of the land forms and soil textures of this county was accomplished in accordance with accepted principles of observation and inference (2). Field trips were made to the area for the purposes of resolving ambiguous details, correlating airphoto patterns with soil textures, and to secure soil samples. Test data included herein were obtained from laboratory testing accomplished on these samples. Standard mapping symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to delineate land forms and soil textures. The text of this report largely represents an effort to overcome the limitations imposed by adherence to a standard symbolism.

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An approach towards better utilization of engineering soil maps of Indiana has been attempted with the inclusion of soil profile and laboratory classification for the principle soils represented within this county. Certain soils of obvious inferior engineering qualities, were not sampled but were indicated on the attached map. The profiles of these soils were compiled from the agricultural literature. These soils include principally organic materials such as muck, peat and highly organic soils which are of only limited extent.

Liberal reference was made to the "Soil Survey of Noble County, 1953" published by the United States Department of Agriculture and "The Formation, Distribution and Engineering Characteristics of Soils", (4) published by the Engineering Experiment Station of Purdue University. In many instances the agricultural soils map did provide a convenient endorsement of the photo interpretater's judgment.

INTERPRETATION OF AREA

General

Noble County is located in the northeastern part of Indiana as shown in Fig. 1. The county is nearly rectangular in shape, with a length of 24 miles (east-west) and a maximum width of 18 miles (north-south). It comprises an area of 412 square miles (3). Albion is the county seat located near the center of the county. A population of 28,162 inhabitants resided within the county with 1325 inhabitants reported for Albion according to the 1960 census (5). The largest city in Noble County is Kendallville with a population of 6765 in 1960 (5). According to the 1950 census of Agriculture there were 246,181 acres of farm land (93.8% of the county area) in Noble county (6). Wooded lands are scattered throughout the county in small patches as shown in the airphoto mosaic in Fig. 2.

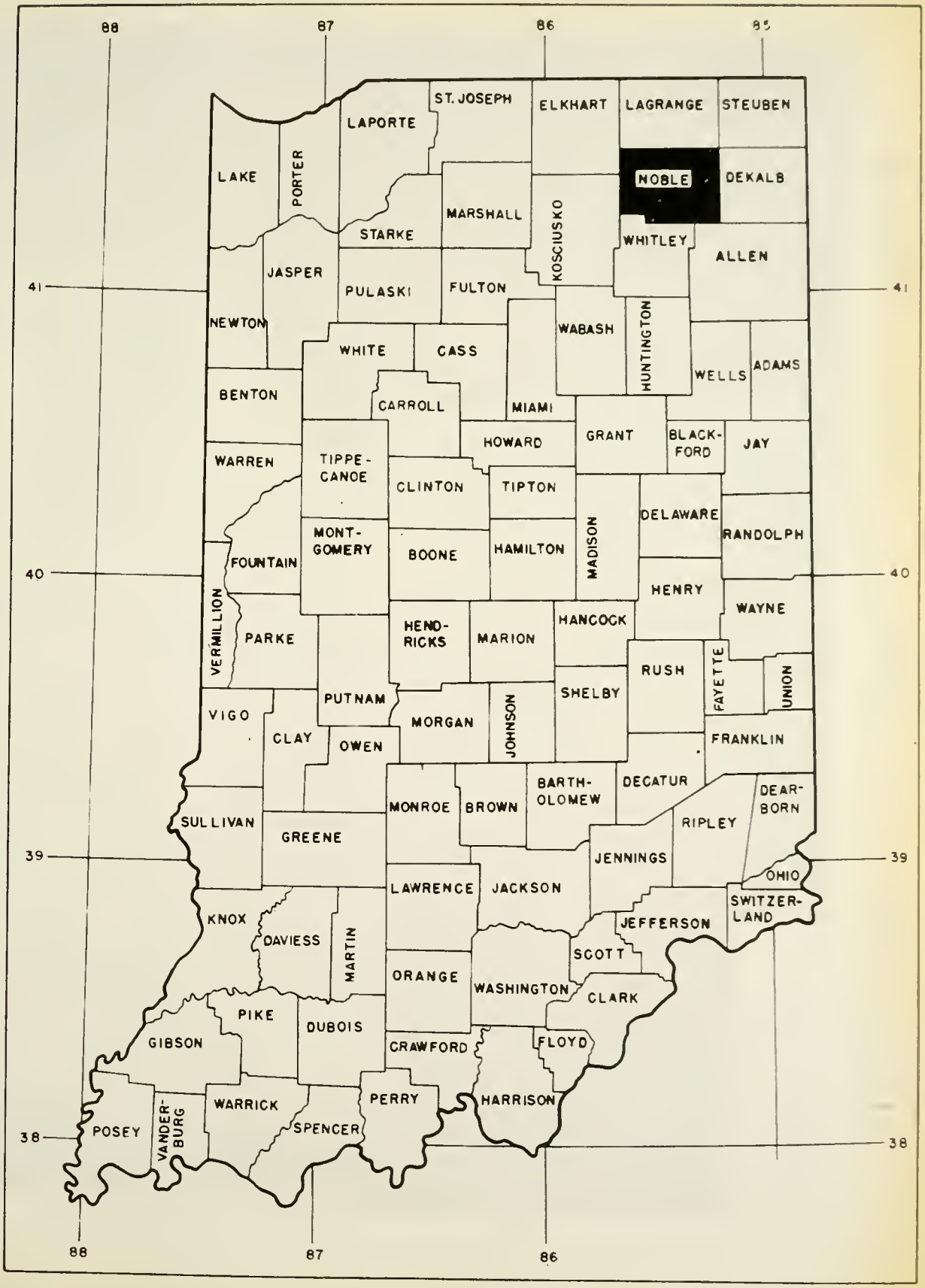


FIG. 1. LOCATION MAP OF NOBLE COUNTY

FIG. 2 AIRPHOTO MOSAIC OF NOBLE COUNTY

FROM 1939 INDEX MAP

Drainage Features

Noble County lies in three major drainage basins of the state. The eastern part is in the Maumee, the southern part is in the Wabash and the central and northern parts are in the St. Joseph drainage basin. The principal stream in the county is the Elkhart River. With its tributaries, namely the north branch and the south branch, more than one half of the county is drained into the St. Joseph River to the west. Natural drainage is weakly developed in most of the county, especially in the northwestern quarter where granular materials are concentrated (see Fig. 3).

There are about 60 lakes or ponds in Noble County. Most of them are located along the major drainage channels (see Fig. 3). The largest (about one square mile in area) is named Sylvan Lake located east of Rome City. A large number of lakes are being rapidly encroached upon by the growth of aquatic vegetation and are approaching extinction.

Climate

Noble County has a humid, temperate and continental climate. The variations between winter and summer temperature are wide, ranging from a maximum of 105 degrees in August to a minimum of -21 degrees in January. The average annual precipitation is 32.68 inches. The normal monthly and the annual temperature and precipitation at Albion are summarized in Table I (7).

Physiography

Noble County is included in the Steuben Morainal Lake Section of the Northern Moraine and Lake physiographic region of the state (8, p.66).

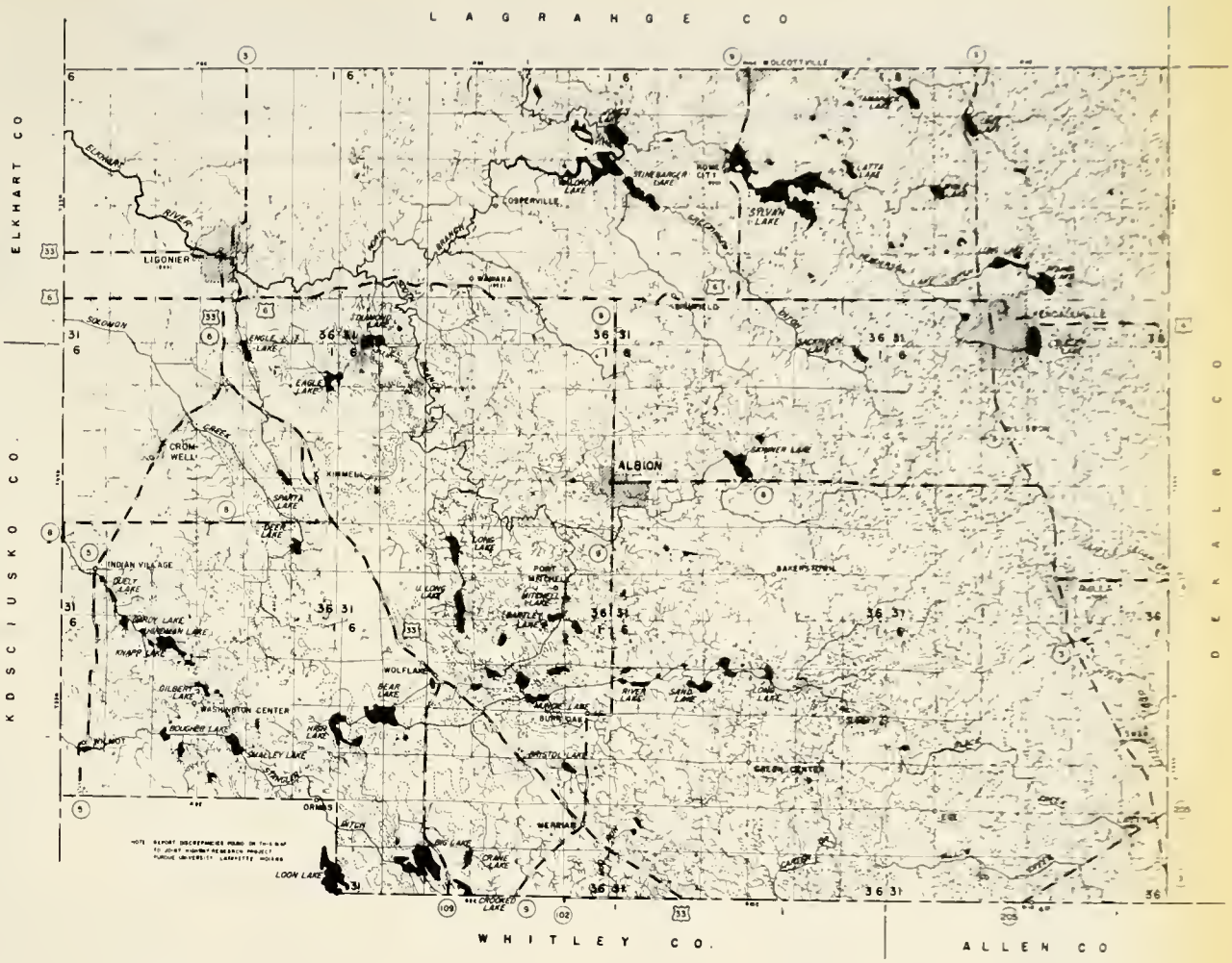


FIG. 3

DRAINAGE MAP

NOBLE COUNTY

INDIANA

PREPARED FROM

1938 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1953

SCALE OF MILES

Table 1

Normal Monthly, Seasonal, and Annual Temperature and Precipitation at Albion, Noble County, Indiana (Elevation 983 feet)*

Month	Temperature			Precipitation		
	Mean °F	Absolute Maximum °F	Absolute Minimum °F	Mean in.	Total for the Driest Year inches	Total for the Wettest Year inches
Jan.	25.9	57	-21	2.18	1.01	1.82
Feb.	26.4	68	-18	1.55	0.70	2.67
Mar.	35.2	78	- 6	2.32	1.66	4.55
April	47.7	89	10	2.58	1.52	4.85
May	58.8	94	22	3.25	0.92	1.90
June	69.2	99	36	3.78	1.93	6.32
July	73.2	104	42	3.44	1.32	6.37
Aug.	71.2	105	42	3.51	3.06	7.69
Sept.	64.0	102	30	2.90	4.91	1.23
Oct.	52.9	89	16	2.91	0.53	9.52
Nov.	38.5	75	- 3	2.45	2.89	1.80
Dec.	27.9	62	-20	1.81	1.23	1.38
Annual	49.3	105	-21	32.68	21.68 (in 1934)	50.10 (in 1954)

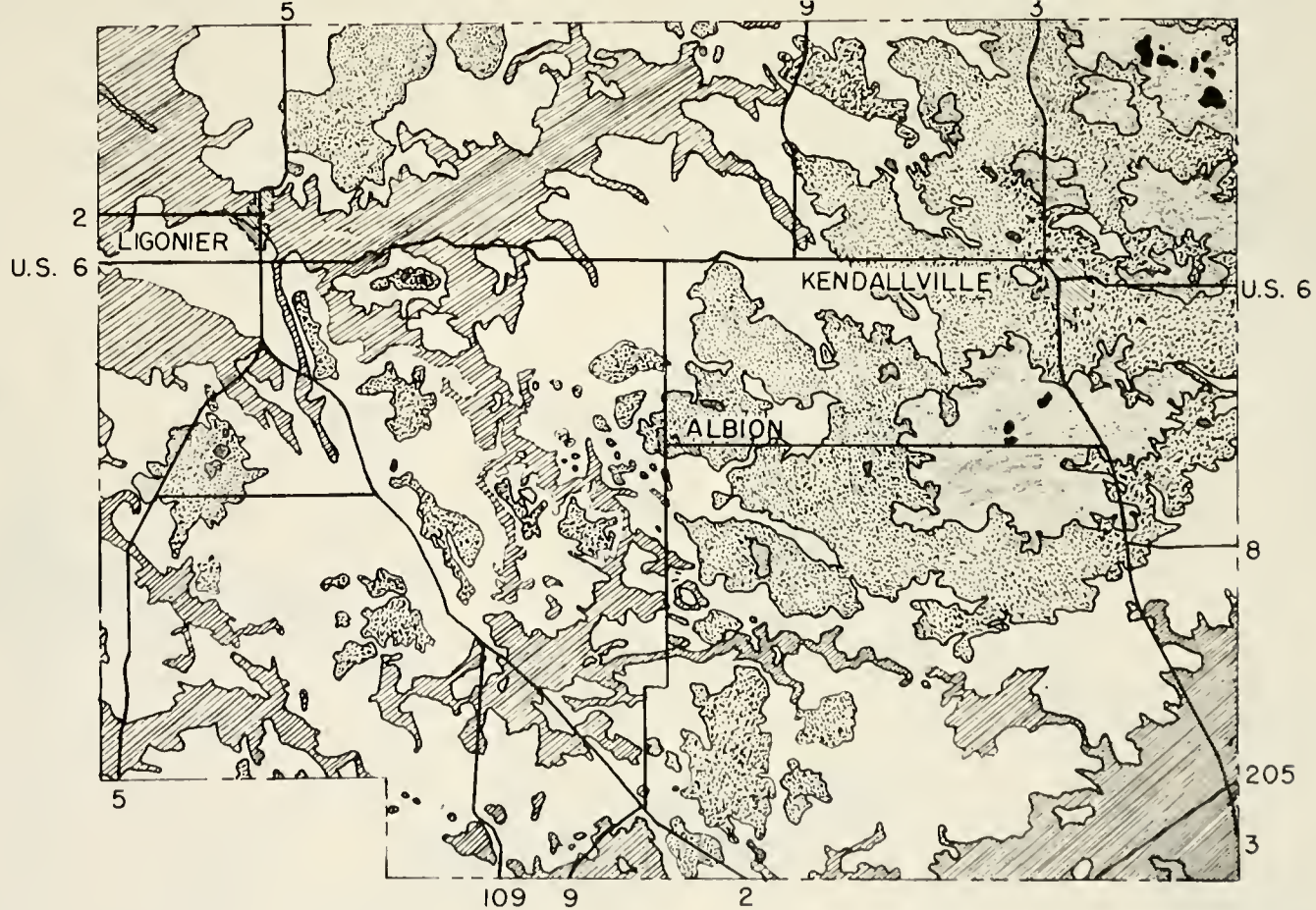
* The elevation of the station has been changed throughout the years from 919 feet (till Jan. 1953) to 960 feet than 930 feet and to the present 983 feet since Feb. 1961. Compiled from the "Climatological Data of Indiana" on a 44-year record through 1961.

With respect to its physiographic situation in the United States, the county is a part of the Eastern Lake Section of the Central Lowland Province (8, pp. 69.)

Topography

The terrain of Noble County is dominated by the massive Mississinewa moraine extending nearly north--south through Kendallville. The remainder of the county slopes gradually away from this ridge as shown in Fig. 4. The average altitude is approximately 950 feet above sea level (8). Sand Hill, the highest point within Noble County, with an elevation of 1070 feet above sea level, is located at the northeastern corner (Sec. 2 T35N, R11E) of the county (9). Another high feature is found north of Diamond Lake at Diamond Hill about three and one-half miles from Ligonier. It has an elevation of 1050 feet above sea level and stands like a magnificient island above the lowlands (175 feet above Diamond Lake). The lowest altitude of 845 feet occurs in the valley of Willow Creek at the southeastern corner of Noble County.

The Mississinewa moraine covers the eastern half of the county (see Fig. 5). Elevation differences on the moraine range from about 950 feet at the southern boundary to 1050 feet at the northeast border. The moraine rises from either side by successive elevations to an undulating table land. The most prominent table land is found south of Kendallville. Other near flat lands occur east of Kendallville, about midway between Albion and Avilla and northeast of Merriam. In general, the moraine has a rolling to hilly topography with strong morainic expression toward the northeast where local relief differences of 70 feet are not uncommon. The moraine is crossed by two east-west



1050' UP

1000' TO 1050'

950' TO 1000'

900' TO 950'

850' TO 900'

800' TO 850'

DERIVED FROM THE FORT WAYNE (NK 16-9) NATIONAL TOPOGRAPHIC 1° QUADRANGLES, SCALE 1/250,000

FIG. 4 TOPOGRAPHIC MAP OF NOBLE COUNTY.

(CONTOUR INTERVAL 50')

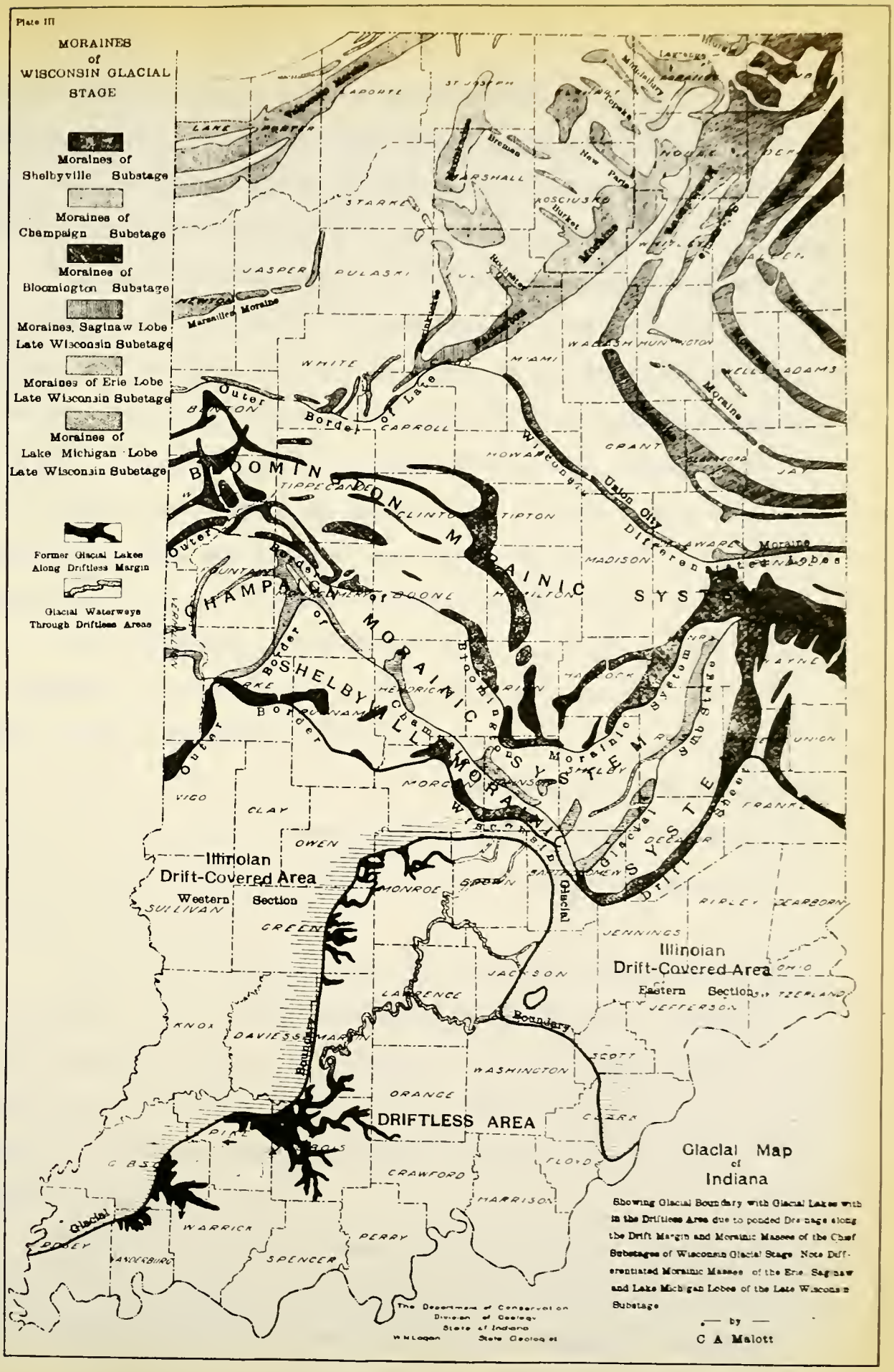


FIG. 5 GLACIAL MAP OF INDIANA

troughs. The one south of Albion is characterized by a group of sand knobs among which are scattered small lakes forming a chain(10). The other, less pronounced, lies immediately north of Kendallville. The surface is about 20 to 50 feet below the surrounding uplands.

The Salamonie moraine is located near the southeastern corner of the county. It is a plain that slopes gently to the southeast (from 1030 ft. to 880 ft.). Its surface presents the succession of swell and hollow. In general, there is not an elevation of sufficient magnitude to be called a hill except in the area about three miles northwest of Avilla where hummocky topography prevails. The altitude in that area is slightly higher than the border of the Mississinewa moraine. A few knolls of 1050 feet in elevation are located in this area.

The southwestern quarter of the county is occupied predominately by the massive Packerton moraine of the Saginaw lobe (see Fig. 5). A gently rolling or swell and sag topography is found at the southern part of this moraine. This gentle landscape changes abruptedly into a rugged valley and ridge topography southwest of Albion. The ridges and valleys are in a southeast-northwestern trend with local relief differences up to 70 feet in many places.

Many isolated morainic areas are found in the northwestern quarter of the county. They are surrounded either by outwash plains or marshes. Many of them have swell and sag topography. The most rugged morainic features occur immediately north of Diamond Lake. Northeast from Ligonier a kettle-kame or highly pitted moraine is found. This is a branch of the Lagrange moraine.

Near level or smooth outwash plains are located mostly in the western half of the county. The severely pitted outwash plains are found most frequently adjoining the massive Mississinewa moraine to the east.

There are numerous marsh basins and a large number of lakes throughout the county. However, the greatest concentration occurs immediately west of the Mississenewa moraine. A few ground moraine areas or till plains are found in the western part of Noble County. They are limited in extent and exhibit a flat or gently undulating topography.

A near level lakebed area is located about three miles south of Wolf Lake. It is 920 feet in elevation and is surrounded by outwash plains and marshes with a small stretch of ground moraine on the east.

Geology

Noble County is covered entirely by glacial drift. The mantle of the drift is probably nowhere less than 200 feet thick while upon the crest of the moraine it is nearly 500 feet (10). Boring for gas at Albion furnished the following log (10):

yellow clay	10 ft.
blue clay	10 ft.
sand and gravel	115 ft.
blue clay	20 ft.
sand and gravel with streaks of blue clay	50 ft.
blue clay	2 ft.
sand and gravel	81 ft.
blue clay	2 ft.
quicksand	5 ft.
blue clay	24 ft.
quicksand	4 ft.
blue clay	7 ft.
sand and blue clay	10 ft.

gravel	5 ft.
red boulder clay	15 ft.
sand	5 ft.
slate	1 ft.
sand	9 ft.
Total depth	375 ft.

Boring at Kendallville is similar to that at Albion except that the drift is about 100 ft. deeper. About 230 feet of glacial drift is found near Leotto (11).

The bedrock formations of Noble County are composed of sedimentary rocks of Mississippian age in the northern part and of Devonian age in the southern part of the county. The following geological divisions are recognized in the records of wells (11, p. 452).

Quaternary	clays, and sands (recent) clays, sands, gravels (Pleistocene)
Mississippian	shales, sandstones (Borden) limestone (Borden)
Devonian	shales (New Albany) limestones (Sellersburg, Jeffersonville) sandstone (Pendleton)
Silurian	limestone (Huntington, Liston Creek) shale (Mississinewa) limestone (Brassfield)
Ordovican	limestone, shales (Richmond-Edden) limestone (Trenton)Mohawkian

AIRPHOTO INTERPRETATION OF SOIL AREAS

Soils in Noble County are derived chiefly from glacial deposits. However, an appreciable amount of glacial-fluvial and alluvial deposits are recognized. Only a very limited extent of eolian deposits are found within the county.

GLACIAL DEPOSITED MATERIALS.

Noble County is covered entirely by deep glacial drift. The characteristics of the drift varies considerably with land form of deposition and the source of the glacier. The various deposits are discussed as follows:

(1) Kettle-Kame Moraine

The kettle-kame morainic areas occur in the western half of the county. They are limited in extent and are often isolated or separated by outwash plains or marshes. The landscape varies from rugged kettle-kame topography to moderately irregular hills and swales.

Parent materials in these areas are generally coarse-textured with higher clay content on those moraines located near the border of DeKalb County. Pedologically, the soils of this region belong to the Fox and Miami Series, predominately the Fox sandy loam, Kame phase. The surface and subsurface soils are shallow at the top of the knoll and are deeper toward the foot of the knoll. Cross bedding of sand and gravel are revealed in many gravel pits. The A-horizon of a typical kame profile ranged from zero to 15 inches in depth, a yellowish brown sandy loam. The B-horizon, from 15 to 36 inches in depth, contains a little more clay and is slightly more plastic than the topsoil. It is

a yellowish brown, gravelly, sandy-clay loam. The C-horizon, located 15 to 52 inches from the surface, contains no or very little clay. It is a pale yellow, highly calcareous, stratified gravelly sand. The amount of gravel varies from one knoll to the other. Cobble stones might occur among the sand and gravel.

Less granular and more clayey soils may be found on the lower slopes in association with the typical kame profile. The surface soil varies from a loam to a clay-loam. The subsoil ranges from clay loam to clay, and the parent material is a light to medium textured, highly calcareous drift.

In the shallow depressions or basins, heavy-textured soils of the Brookston and Kokomo series are predominant, Occasionally coarse-textured soil of the Brady series are found. The surface soils, which vary from sandy loam to silty-clay or clay, contain considerable amount of organic matter. The B-horizon normally contains more clay particles than the surface layer. The parent materials vary from stratified sand and gravel to a medium-or heavy-textured glacial till. In the deep depressions or basins, especially those surrounded by high knolls, a colluvial soil is usually present. It belongs to the Washtenaw series. The materials are light grayish brown friable silt loam or intermixed layers of clay, silt and sand. The thickness of the colluvial deposit varies from 1 to 10 feet. The underlying materials are dark colored, heavy textured soils of the Brookston and Kokomo series.

Many gravel pits are developed in the kettle-kame morainic deposits especially those in the western half of the county.

(2) Ridge Moraines

Ridge moraine deposits occupy more than half of the area of Noble County. They can be subdivided into different textural groups, namely the gravelly textured moraine, the sandy textured moraine, the silty textured moraine and the clayey textured moraine. Each group is discussed in detail as follows:

(a) Gravelly textured ridge moraine

The gravelly textured ridge moraines are also scattered throughout the county. They are small in extent and located near outwash plains or glacial-fluvial valleys. The most prominent isolated masses are located north of Kimmell, in the vicinity of Albion, northeast of Kendallville and in the southeastern quarter of the county. They range from low hills and swales to a pitted surface. The topography is much more subdued than that of the kettle-kame moraine.

Engineering soils of this group, in general, are sandy to gravelly in texture. They belong to the Fox and Miami series pedologically. The surface soils are chiefly sandy loam but loam or clay loam may appear in places. The B-horizon contains a little more clay than the layer above. The parent materials vary from a stratified sand and gravel (SW, SP, or A-1-b soil) to sandy loam (SM or A-2-4) soil. Occasionally, loam to clay loam parent materials are formed in this region. The soil sample taken at site No. 3 is not a typical profile for this region. However, it shows the possible variation and the granular nature of this deposit. The test data (see Table 2) indicate that the soil is very sandy throughout the entire profile. The soil profile in the depressions is the same as that of the kettle-kame moraine. A number of gravel pits are located within this deposit. Most of them lie on the eastern half of the county.

(b) Sandy Ridge Moraine

A great portion of Noble County is occupied by the sandy ridge morainic deposit. The main sections of this moraine are located in the southwestern quarter, and the northeastern corner of the county. The continuity of the mass is destroyed by a great number of outwash plains and muck channels which cut across the moraine. The topography is generally rolling to undulating with occasional hilly or hummocky areas. It exhibits a pitted airphoto pattern on the sandy ridge moraine located in the northwestern part of the county as shown in Fig. 6.

The majority of the soil in this area belongs to the Miami series. The surface texture varies from loose sandy loam to friable loam or clay loam. The B-horizon varies from a gravelly or sandy clay loam to clay. The parent material is composed of sandy loam, loam, silt loam, or clay loam with slightly increased amount of gravel content. Soil samples were taken at site Nos. 2, 4, and 9. Although none of the samples can be classified as sand by the AASHO classification, they contain appreciably more sand than the soil found in the silty and clayey ridge morainic areas to be discussed later.

The most typical soil for the sandy ridge morainic area is located at site No. 4. The sample taken at site No. 9 near the border of a flat, silty ground moraine to the north, shows an unusual soil profile. The test site is situated on the foot slope of a mound. The surface soil, about 9 inches in depth, is a dark colored organic sandy loam. The soil changed into a light yellowish brown loose sandy loam immediately beneath the topsoil. A heavy textured clay loam is encountered from 36 to 50 inches. The C-horizon taken directly below is a silty clay loam.

FIG. 6 AIRPHOTO PATTERNS OF KETTLE KAME MORAINE, SANDY RIDGE MORAINE, PITTED OUTWASH PLAIN, GRAVELLY AND SANDY OUTWASH PLAINS, SILTY GROUND MORAINE AND THIN DRIFT ON OUTWASH IN NOBLE COUNTY.

In the depressions, soils of Brookston and Kokomo series are predominant. The topsoil is a highly organic silty clay to clay. The subsoil has more clay content than the above layer and is generally classified as clay. The parent material is a medium textured loam or clay loam glacial drift. In the more rugged areas, where erosion is pronounced, the soil of the Washtenaw series is likely to be found. These light colored colluvial soils are deposited on top of the dark colored Brookston or Kokomo soil.

Gravel pits are very few and are widely scattered in this land form.

(c) Silty Ridge Moraine

The silty ridge moraine is confined to the eastern half of Noble County. It lies entirely within the Mississinewa moraine of the Erie lobe. The topography varies from hilly or rolling to undulating. The rugged topography (with local relief up to 60 feet) is located east of Albion and in the vicinity of Green Center. The landscape becomes more gentle toward the south and east.

Soil of the region is chiefly of the Miami series. The soil profile consists of a loam to clay loam topsoil, a clay loam to clay subsoil and a loam to silt loam parent material.

Soils of the Brookston and Kokomo series are predominant in the depressional areas. They are characterized by a silty clay to clay topsoil, a slightly more clay content subsoil and a more coarse textured parent material (loam to clay).

(d) Clayey Ridge Moraine

The clayey ridge moraine is located in the southeastern corner of the county and extends about 70 square miles in area. It has a strong hilly or hummocky topography in the section located about 3 miles west of Lisbon and also in a small area about 2 miles northwest of Ege. The rest of the area is gently rolling to undulating and becomes more subdued toward the east.

The soil is this region is developed from a heavy textured glacial till which contains large quantities of dark gray shale. It belongs to the Morley series pedologically. The soil profile consists of a grayish brown firable silt loam topsoil, a clay subsoil and a highly calcareous, clayey parent material.

A soil sample was taken at site No. 7. The A-horizon showed a thin (about 5 inches in depth), low organic content, grayish brown heavy silt loam. The B-horizon taken from 10 to 20 inches was a heavy clayey soil. The C-horizon showed about the same percentage of clay content but with considerably more shale pebbles in the profile. The parent material was somewhat less clayey or plastic than the layer above and is classified as clay soil.

In the depressional areas soils of the Brookston and Kokomo series are predominate. The surface soil is a very dark gray silty clay or clay relatively high in organic content. The B-horizon is a mottled gray, yellow and brown plastic silty clay, clay loam or clay. The parent material is a lighter textured glacial till which varies from sandy clay to clay loam or even clay.

(3) Ground Moraine

A number of ground moraines are recognized in Noble County. They are small in area (generally less than 5 square miles) and widely scattered over the county. The majority of these are silty in texture. However, sandy and clayey textured ground moraines are found within the county.

(a) Sandy textured ground moraine

The only sandy textured ground moraine is located north of Rome city and south of Wolcottville. It is about 2 square miles in area. It exhibits a gently undulating topography.

Pedologically, the soil belongs mainly to the Miami sandy loam series. The soil profile is characterized by a loose sandy loam topsoil, followed generally by a sandy clay loam B-horizon and then a sandy loam parent material. However, variation may be encountered in the B- and C-horizons. In the B-horizon a clay to clay loam soil may be found, while within the C-horizon a loam or silt loam glacial till may be present.

Soils in the depressions belong to the Brookston series. They have a dark colored silty clay to clay topsoil, a silty clay to clay subsoil and a loam to clay glacial till parent material.

(b) Silty textured ground moraine

The silty textured ground moraines are located mostly in the western half of the county where the deposits are related to the Saginaw glacial lobe. The topography varies from near level to gently undulating. The typical Wisconsin till plain airphoto pattern can be seen on Fig. 6.

Pedologically the soils of this deposit belong to the Miami-Crosby-Brookston catena. The soil profile consists of a loam to silty clay loam topsoil, a clay loam to clay subsoil and a loam to clay loam parent material. Samples taken at sites No. 11, 15 and 18 show the variation of the soils in this region.

In the slight depressions silty clay loam soil of the Brookston series predominates. The surface horizon is a very dark gray, high organic content, silty clay or clay soil. The B-horizon contains more clay than the A-horizon, and the clay portion is reduced somewhat in the C-horizon. Both the B- and the C-horizon are likely to be classified as clay, a CL soil. However the B-horizon may be classified as A-7-6 soil and the C-horizon an A-6 soil by the AASHO system.

(c) Clayey textured ground moraine.

A clayey textured ground moraine is located on the southeastern quarter of Noble County. It is small in extent and exhibits a very flat topography. The soils in this area are derived from the clayey Erie moraine and belong to the Morley-Blount catena. The soil profile consists of a silt clay loam top soil, a heavy clay B-horizon and a clayey C-horizon.

A soil sample taken at site No. 6 gave the following profile. The A-horizon, taken from the surface down to 10 inches was a brownish gray friable silt loam with relatively high organic matter content. Both sand and silt contents decreased in the B-horizon while the clay content increased accordingly. In the C-horizon the clay content was somewhat reduced and numerous, partly weathered, shale fragments were present. The parent material is classified as a clay soil.

(4) Thin Drift on Outwash

An area, about 6 square miles in extent, located northeast of Ligonier is a region that has a flat to undulating overall topography. Numerous current scars and infiltration basins occur on the airphotos (See Fig. 6). The surface indicates that a faint surface drainage system is developing. This deviation from the true outwash plain drainage pattern reveals the presence of different materials overlying the outwash plain.

The soil in this region is developed on highly calcareous glacial till, underlain by loose gravel and sand at depths from 4 to 10 feet. The upper part of the profile is essentially the same as Miami loam and the profile belongs to the Wawaka series.

The soil profile consists of a loam to clay loam topsoil, a clay loam to clay B-horizon, a loam to clay loam C-horizon and this is underlain by stratified gravel and sand.

Soil of the Grismore series may be found in the depressions. It is characterized by a loam to clay loam topsoil followed by a clay loam to clay subsoil and then a loam to clay loam parent material which rests on stratified sand and gravel found at a depth from a little over 3 feet to about 10 feet.

(5) Eskers and Kames

Although many kames exist in Noble County, they are located mainly in the kettle-kame morainic belt; therefore, it is impractical to outline each individually on the map. However, a few prominent ones on the silty and sandy textured ridge moraine are outlined on the map.

There are a number of short, small eskers in the county. They

are very easily delineated on the airphotos, and are shown individually on the soil map. Almost all of them are located near the drainage channels within the southern half of the county. There is one, however, nearly one mile long, located near Brimfield in the northern half of the county.

The soils developed on these formations are generally of the Fox series. The typical profile is about the same as that of the Kettle-Kame moraine.

WATER DEPOSITED MATERIALS

Extensive areas of water deposited materials exist in Noble County. Five different land forms created by the action of water, namely: outwash plain, terrace, lacustrine plain, alluvial plain and beach are discussed as follows:

(1) Outwash Plains

Nearly half of the northwestern section of Noble County is occupied by outwash plain deposits. Others are located near Burr Oak and east of Bakerstown. They are discussed under the following subheadings: pitted outwash, gravelly outwash, sandy outwash, highly organic topsoil outwash, thin outwash on drift and thin outwash on lakebed.

(a) Pitted outwash plain

The most prominent pitted outwash plains are located north of Kendallville, north of Albion and in the vicinity of Washington Center. The topography of the pitted outwash plain is rolling; local relief of 20 to 40 feet in magnitude is not uncommon.

The pitted outwash deposit is mainly granular in texture with occasionally a light textured material intermixed or stratified within the

profile. The major soil of the area belongs to the Fox series with some Miami soil. The soil profile consists of a gravelly sandy loam to loamy topsoil, a gravelly sandy clay loam to clay subsoil, and stratified gravel and sand or a loam parent material.

In the depressions, the soil profile is about the same as that of the low topographic areas within kettle-kame morainic area previously discussed.

Numerous man-made gravel pits are located on these pitted outwash plains.

(b) Gravelly outwash plain

The major portion of the outwash plains in Noble County belong to this category. The topography is nearly level with countless number of infiltration basins and occasionally current scars. (See Fig. 6).

Soil of the gravelly outwash plain in Noble County belongs to the Fox and the Warsaw catena. The soil generally has a gravelly sandy loam topsoil, a slightly higher clay content B-horizon and a stratified sand and gravel C-horizon.

In the depressions or shallow basins soils of the Brady, Westland or Abington series may be found. The depressional soil is characterized by having a dark colored, highly organic sandy loam to clayey loam topsoil. The subsoil may be a sandy loam, a loam, a clay loam or a gravelly clay. This is underlain by a stratified gravel and sand parent material.

Gravel pits are not developed too extensively in this region because the deposit contains a high percentage of sand.

(c) Sandy outwash plain

Sandy outwash areas are small in extent and widely scattered within Noble County. The larger areas are located in the northwestern corner of the county and east of Cusperville. The areas are flat and expressionless. There are very few infiltration basins, and yet no surface drainage development is found on the sandy outwash plains.

Pedological soils in this region are chiefly of the Fox, Homer or Bronson series. They usually have a loam to sandy loam topsoil, a sandy clay loam or gravelly loam subsoil and a stratified sand and gravel parent material. Test sites 17 and 24, illustrate the sandy nature of these deposits.

In depressions or basins, the soil profile is similar to that of the gravelly outwash plain.

(2) High organic topsoil/outwash plain

Only a few narrow strips are occupied by the high organic topsoil /outwash plain. All of them are located in the northwestern section of the county. This deposit is developed on the depressional flats. The surface is very smooth and monotonous. These areas all have a uniform dark gray photo tone and are easily delineated on the aerial photographs.

Soils of this region are chiefly of the Ebington, Westland, or Brady series. Homer soil may be found on slightly higher ground. The soil profiles are characterized with a variable topsoil ranging from clay to sandy loam with high organic content within the upper 10 inches. The B-horizon also varies from a sandy or gravelly clay loam to clay with different amounts of gravel, the parent material is composed of stratified sands and gravels.

(3) Thin outwash on drift

The thin outwash on glacial drift deposit is very limited in Noble County. It occurs in the vicinity of Kendallville and is less than one square mile in area. Although this area has an overall plain surface, many kettle like depressions are found. There is no surface drainage development on this deposit.

Soil of this region is designated as Kendallville by the pedologist. It is characterized by having a sandy topsoil and subsoil and a medium textured glacial till below.

(4) Thin outwash on lakebed

There are two separate areas in Noble County having a thin outwash deposit overlying a clayey lakebed. The larger one, a little over 2 square miles in size, is located about 2½ miles east of Albion. The smaller one, less than 1 square mile, lies about 4½ miles west of Merriam. These deposits are closely associated with the low muck basins. This deposit exhibits a till plain like airphoto pattern. The surface is nearly level but it is disturbed by some faint infiltration marks and scattered surface drainage gullies.

Berrien, Ottawa, or Wauseon series are the major pedological soils of this deposit. The soil profile consists of a sandy or sandy loam topsoil, a little heavier subsoil overlying a lacustrine clay with thin lenses of sand and silt at a depth varying from 2 feet to 6 feet below the surface.

In the depressions within this region the sandy outwash may be absent and a truly lacustrine lakebed deposit occurs. Toledo or Boxo soils may be found. The profile is a clayey soil throughout.

(5) Terraces

Terraces are generally found along major drainage channel. In Noble County, however, no well defined terrace land form can be observed. The only one that may be considered as terrace is located on the south-eastern corner of the county. The characteristic break between upland and terrace is not present. Some infiltration basins and current marks occur on the airphoto pattern of this area.

The terraces are composed of stratified sands and gravels. However, the upper portion of the terrace usually exhibits a cover of silty clay material. The depth of the overburden and the composition of the deposit varies greatly from place to place.

The major pedological soil of the terrace is generally of the Fox series. The surface soil varies from sandy loam to loam; the B-horizon is generally a sand loam and the parent material a stratified gravelly sand.

(6) Lacustrine plain

There are a few lacustrine deposits in Noble County. The largest one, about 2 square miles in area is located about 4 miles west of Merriam. Small lacustrine plains are situated about 2 miles east of Albion and at the southeastern corner of the county. The lacustrine plains are generally nearly level, and are only slightly higher than their adjacent muck basins.

A uniform gray tone is registered on the airphotos and no surface drainage development is shown in this area.

Fulton and Toledo are the major pedological soils in this area. The soil profile is characterized by having a silt loam to clay topsoil or organic clay, a high clay content B-horizon and a clayey parent material.

In the shallow depressions Bono soil is predominant. The soil profile consists of a dark gray, high organic, clay topsoil, a gray clay subsoil and a highly calcareous clay with occasional thin seams of silt or very fine sand parent material.

(7) Alluvial Plain

Practically all drainage channels possess recent alluvial plains (flood plains); however, only those of considerable size are shown on the engineering soils map because of scale limitation.

The largest alluvial plain in Noble County is associated with the Elkhart River. The others are located mostly in the southeast quarter of the county. Most of the alluvial plains are flat.

The texture of the alluvial deposits varies greatly from one place to the other depending mainly on the nature of the drainage basin. Those that are located in the northwestern section of the county are coarse in texture. Griffin soil is predominant in this section. It is characterized by having a loamy topsoil and a loam to sandy loam subsoil that grades into stratified sand, silt, clay and gravel at various depth.

The texture of the alluvial plains in the other sections is finer than those aforementioned. Since they are derived from silty or clayey upland soils, the texture of the A-horizon varies from loam to silt loam or to a silty clay loam. The subsoil varies from silt loam to loam with occasional thin layers of fine sand. Sand and gravel may be found at a depth of about 40 inches from the surface. Pedologically this soil belongs to the Eal series.

(8) Sand Beach

South of Wolf Lake in the southwestern quarter of Noble County there are sand beach deposits. This sand occupies areas bordering lakes

where the water table has been lowered. The material consists chiefly of a mixture of fine sand and coarse gravel with occasional large rounded stones. The material is stratified in places and its composition varies.

WIND DEPOSITED MATERIAL

There are a few limited eolian sand deposits within the county. They are located on the sandy ridge moraine about 3 miles southwest of Wolf Lake. Part of the materials may be a morainic deposit, and the top part is definitely a deposit of the subsequent wind action. The shape of the sand dunes is irregular and far from their typical form. This deposit is classified as Colema soil by the agricultural soil scientist. It has a sandy topsoil and a feebly coherent subsoil with occasional heavier textured lenses 3 or 4 inches thick. The nearly uniform sand is considered as a poorly graded sand.

MISCELLANEOUS FORMATIONS

(1) Peat and Muck Depressions

The chief organic soil of Noble County is muck that occurs in numerous kettle depressions. Peats are found underlying the decomposed muck in many places where oxidation is very slow or ineffective.

The peat and muck soil in Noble County is recognized as Carlisle muck, Edwards muck, Houghton muck and Kerston muck by the agronomist. Most of the peats are derived from Sphagnum mosses. For quantity and quality of peat, Noble County ranks as one of the foremost counties of the state (12). The peat deposits vary in size and depth. The large ones may be up to 500 acres in area, and the organic material may be as thick as 21½ feet in places (12). Marl from 1 to 3 feet in depth may be found

underlying the peat and muck deposits in some areas. It is a soft earthy material composed principally of an amorphrous form of calcium carbonate. Since it is also undesirable from the engineering standpoint, no separation is made from the peat and muck in the general soil profile.

Since the size and depth of these deposits varies greatly from one deposit to the other, field investigation for each individual deposit is necessary before final design is made.

(2) Highly organic topsoils

Depressed areas, where internal drainage is somewhat retarded by the high ground water table, give rise to the accumulation of considerable amounts of organic topsoil. There are a number of such areas in Noble County. Some of them are located next to the muck pockets. The parent material underlying the organic topsoil is essentially the same as those of the surrounding mineral soil areas. Where large areas exist, an organic symbol is used on the attached map to delineate possible problem soil areas.

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Site No.	Horizon	Depth in Ft.	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
1	A	0 - 5/6	5	18.2	CL	A-6(10)
	B	5/6-2 3/4	5	19.7	CH	A-7-6(17)
	C	2 3/4-4	5	17.3	CL	A-7-6(13)
2	B	5/6-2 1/3	15	11.5	CL	A-4(4)
	C	2 1/3-3 1/3	2	14.7	CL	A-6(8)
3	A	1/3 - 1	18	11.6	SM	A-2-4(0)
	B	1 2/3-3 1/3	16	11.3	SM	A-2-4(0)
	C	3 1/2-5 1/2	24	10.8	SM	A-2-4(0)
4	B	5/6-3 1/3	4	13.3	SM-SC	A-4(3)
	C	3 1/3-5	5	9.6	SM	A-4(2)
5	B	5/6-6	20	10.2	SM	A-2-4(0)
	C	8-10	19	10.1	SM	A-4(2)
6	A	0-3/4	4	19.2	CL	A-6(10)
	B	5/6-1 2/3	8	19.5	CH	A-7-6(20)
	C	1 2/3-3	4	12.2	CL	A-6(11)
7	B	5/6-1 2/3	10	17.6	CL	A-7-6(13)
	C	1 2/3-2 1/3	4	10.7	CL	A-6(10)
8	B_1	5/6-3 5/6	5	10.6	SM	A-2-4(0)
	IIB_2	3 5/6-6	6	19.3	CL	A-6(11)
	C	6-6 2/3	5	24.5	CH	A-7-6(19)
9	B_1	5/6-3	35	10.1	SM	A-2-4(0)
	B_2	3-4 1/6	10	11.4	CL	A-4(7)
	C	4 1/6-6	7	9.2	ML	A-4-(7)

TABLE II

SOIL TEST DATA FOR MOBILE COUNTY

Site No.	Horizon	Depth in Ft.	Grain Size Distribution: Gravel % Retained on #4	Fine Gravel % Retained #4-#10	Coarse Sand % Retained #10-#40	Fine Sand % Retained #40-#200	Silt % < #200 >0.005 mm	Clay % < 0.005 mm	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T99): O.M.C. %	Max. Dry Weight pcf	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
1	A	0 - 5/6	1	0	5	15	44	35	38	16	17.9	106.2	5	18.2	CL	A-6(10)
	B	5/6-2 3/4	0	1	3	12	25	59	51	28	19.5	105.5	5	19.7	CH	A-7-6(17)
	C	2 3/4-4	2	1	5	15	24	53	44	21	17.2	111.4	5	17.3	CL	A-7-6(13)
2	B	5/6-2 1/3	1	3	8	33	28	27	24	8	11.9	120.6	15	11.5	CL	A-4(4)
	C	2 1/3-3 1/3	3	1	6	18	40	32	31	13	14.5	117.4	2	14.7	CL	A-6(8)
3	A	1/3 - 1	3	4	15	48	17	13	19	--	11.4	116.2	18	11.6	SM	A-2-4(0)
	B	1 2/3-3 1/3	6	4	18	46	13	13	16	--	11.2	121.1	16	11.3	SM	A-2-4(0)
	C	3 1/2-5 1/2	7	5	19	48	13	8	15	--	10.5	121.9	24	10.8	SM	A-2-4(0)
4	B	5/6-3 1/3	4	2	12	33	19	30	24	8	12.7	117.4	4	13.3	SM-SC	A-4(3)
	C	3 1/3-5	6	4	11	33	28	18	16	4	9.3	130.2	5	9.6	SM	A-4(2)
5	B	5/6-6	0	1	18	64	5	12	NL	--	10.1	120.7	20	10.2	SM	A-2-4(0)
	C	8-10	4	2	10	37	25	22	18	5	9.9	126.7	19	10.1	SM	A-4(2)
6	A	0-3/4	0	1	6	18	40	35	39	16	19.4	102.4	4	19.2	CL	A-6(10)
	B	5/6-1 2/3	0	0	3	11	31	55	58	33	19.9	103.3	8	19.5	CH	A-7-6(20)
	C	1 2/3-3	0	1	5	10	36	48	39	18	13.8	111.0	4	12.2	CL	A-6(11)
7	B	5/6-1 2/3	0	1	5	18	25	51	46	20	19.3	104.0	10	17.6	CL	A-7-6(13)
	C	1 2/3-2 1/3	2	2	5	15	26	50	36	16	15.8	114.2	4	16.7	CL	A-6(10)
8	B_1	5/6-3 5/6	6	6	12	41	20	15	16	3	10.6	124.4	5	10.6	SM	A-2-4(0)
	IIB_2	3 5/6-6	0	0	1	2	42	55	38	17	18.9	106.9	6	19.3	CL	A-6(11)
	C	6-6 2/3	0	0	0	2	12	86	56	30	25.1	97.2	5	24.5	CH	A-7-6(19)
9	B_1	5/6-3	1	1	8	68	9	13	NL	--	10.4	118.0	35	10.1	SM	A-2-4(0)
	B_2	3-4 1/6	0	0	2	30	39	29	27	10	12.6	117.8	10	11.4	CL	A-4(7)
	C	4 1/6-6	3	3	3	21	50	20	16	3	9.6	129.2	7	9.2	ML	A-4-(7)

Site No.	Horizon	Depth in Ft.	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
10	A	0-1			SM	A-2-4(0)
	B	1-2½			SM-SC	A-2-4(0)
	C	2 3/4-4 1/6			SW	A-1-b(0)
11	A	0-3/4	8	10.4	SM-SC	A-4(2)
	B	5/6-3 1/6	11	13.6	CL	A-6(4)
	C	3 1/3-5 1/2	27	7.7	SM	A-4(1)
12	B	5/6-2 1/2	7	12.5	CL	A-6(6)
	C	2 3/4-5 1/3	11	10.6	CL	A-4(4)
13	B_1	1/6-1	9	11.4	SM	A-4(0)
	B_2	1-1 2/3	4	18.8	CL	A-6(9)
	D	1 2/3-2 1/2	4	14.5	CL	A-4-(7)
14	A	1/6-5/6			SM	A-2-4(0)
	B	1-3	2	13.0	SM-SC	A-4(1)
	C	3-5			SW-SM	A-1-a(0)
15	A	0-1	6	16.1	SM-SC	A-4(0)
	B_1	1 1/4-4	13	9.6	SM	A-2-4(0)
	B_2	4 1/6-5 1/2	29	10.7	SM	A-2-4(0)
	C	5 1/2-7 1/3	25	9.7	SW-SM	A-2-4(0)
16	A	1/6-1			SM	A-2-4(0)
	B_1	1-2 2/3	8	10.8	SM	A-2-4(0)
	B_2	2 2/3-3 2/3	15	9.5	SM	A-2-4(0)
	D	3 2/3-7	4	14.4	CL-ML	A-4(8)
17	A	0-2/3	3	18.2	SC	A-6(3)
	B	5/6-2 1/2			SM	A-2-4(0)
	C	2 1/2-4 3/4			SW-SM	A-1-b(0)

TABLE II (Continued)

Site No.	Horizon	Depth in Ft.	Grain Size Distribution: Gravel % Retained on #4	Fine Gravel % Retained #4-#10	Coarse Sand % Retained #10-#40	Fine Sand % Retained #40-#200	Silt % #200 - 0.005 mm	Clay % - 0.005 mm	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T99): O.M.C. %	Max. Dry Weight pcf	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
10	A	0-1	17	9	22	32	15	5	18	--	12.2	118.6			SM	A-2-4(0)
	B	1-2½	17	10	25	26	6	16	23	7	14.0	118.2			SM-SC	A-2-4(0)
	C	2 3/4-4 1/6	16	7	55	19	0	3	NL	--	13.9	121.5			SW	A-1-b(0)
11	A	0-3/4	0	4	11	39	32	14	28	8	13.4	111.4	8	10.4	SM-SC	A-4(2)
	B	5/6-3 1/6	5	4	12	27	21	31	28	12	14.1	116.8	11	13.6	CL	A-6(4)
	C	3 1/3-5 1/2	15	3	10	30	29	13	NL	--	7.8	127.6	27	7.7	SM	A-4(1)
12	B	5/6-2 1/2	1	1	8	30	29	31	27	12	13.5	119.2	7	12.5	CL	A-6(6)
	C	2 3/4-5 1/3	3	3	11	28	30	25	22	8	10.8	123.0	11	10.6	CL	A-4(4)
13	B_1	1/6-1	12	8	29	26	3	22	19	6	11.4	120.5	9	11.4	SM	A-4(0)
	B_2	1-1 2/3	9	5	6	15	25	40	38	18	18.3	109.8	4	18.8	CL	A-6(9)
	D	1 2/3-2 1/2	2	2	8	19	31	38	27	10	14.9	118.3	4	14.5	CL	A-4-(7)
14	A	1/6-5/6	2	3	15	45	20	15	18	4	13.1	118.4			SM	A-2-4(0)
	B	1-3	5	3	15	35	20	24	23	8	13.1	119.8	2	13.0	SM-SC	A-4(1)
	C	3-5	36	16	30	10	4	4	NL	--	10.4	129.0			SW-SM	A-1-a(0)
15	A	0-1	0	2	12	49	27	10	27	7	15.0	108.4	6	16.1	SM-SC	A-4(0)
	B_1	1 1/4-4	1	5	14	53	17	10	NL	--	9.3	123.3	13	9.6	SM	A-2-4(0)
	B_2	4 1/6-5 1/2	12	5	21	46	6	10	NL	--	10.6	121.2	29	10.7	SM	A-2-4(0)
	C	5 1/2-7 1/3	6	1	35	46	6	6	NL	--	10.4	117.2	25	9.7	SW-SM	A-2-4(0)
16	A	1/6-1	2	2	15	46	25	10	28	--					SM	A-2-4(0)
	B_1	1-2 2/3	2	3	13	55	11	16	16	--	10.5	123.5	8	10.8	SM	A-2-4(0)
	B_2	2 2/3-3 2/3	1	5	14	53	13	14	14	--	9.7	122.9	15	9.5	SM	A-2-4(0)
	D	3 2/3-7	0	0	1	8	60	31	26	7	14.4	116.6	4	14.4	CL-ML	A-4(8)
17	A	0-2/3	6	5	17	27	30	15	32	12	18.6	103.6	3	18.2	SC	A-6(3)
	B	5/6-2 1/2	12	8	29	19	17	15	16	--	11.1	124.3			SM	A-2-4(0)
	C	2 1/2-4 3/4	13	9	34	34	4	6	NL	--	11.2	121.9			SW-SM	A-1-b(0)

Site No.	Horizon	Depth in Ft.	C % Re	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
18	A	0-5/6		5	20.2	CL	A-6(8)
	B	1-2 1/2		8	16.6	CL	A-7-6(12)
	C	3-4 2/3		4	20.8	CL	A-7-6(12)
19	A	0-2/3				SM	A-2-4(0)
	B	2/3-2 1/3				SM	A-2-4(0)
	C	2 1/3-3 1/2				SW-SM	A-1-b(0)
20	A	0-2/3				SM	A-2-4(0)
	B	2/3-3				SM-SC	A-2-4(0)
	C	3-6 2/3				SW	A-1-a(0)
21	A	0-2/3		6	19.0	SM	A-5(1)
	B	5/6-2 1/3				SM-SC	A-2-4(0)
	C	2 1/2-4 1/6				SM	A-1-b(0)
22	A	0-2/3				SM	A-2-4(0)
	B	5/6-2 1/3				SM-SC	A-2-4(0)
	C	3-4 2/3		19	10.7	SW-SM	A-1-b(0)
23	A	0-2/3		6	22.6	OL	A-7-5(8)
	B	3/4-1 2/3		5	15.8	CL	A-6(7)
	C	2-3 1/2		5	11.1	SM	A-2-4(0)
24	A	0-2/3		20	10.6	SM	A-4(0)
	B	5/6-3				SM	A-2-4(0)
	C	4 1/2-5 1/6		20	15.8	SP-SM	A-3(0)
25	A	0-2/3		3	19.6	CL	A-6(7)
	B	5/6-1 3/4		5	22.1	CH	A-7-6(20)
	C	2-3 1/2		8	13.8	CL	A-6(7)
26	A	0-1/2		7	26.5	OH	A-7-5(9)
	B	2/3-1 2/3		3	21.6	OH	A-7-5(17)
	C	2 5/6-4 2/3		2	11.2	CL-ML	A-4(2)

TABLE II (Continued)

Site No.	Horizon	Depth in Ft.	Grain Size Distribution: Gravel % Retained on #4	Fine Gravel % Retained #4-#10	Coarse Sand % Retained #10-#40	Fine Sand % Retained #40-#200	Silt % < #200 >0.005 mm	Clay % < 0.005 mm	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T99): O.M.C. %	Max. Dry Weight pcf	CBR (Surcharge 35 lbs)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
18	A	0-5/6	6	1	8	16	41	28	36	13	19.6	101.7	5	20.2	CL	A-6(8)
	B	1-2 1/2	2	3	2	22	19	52	47	23	17.0	103.8	8	16.6	CL	A-7-6(12)
	C	3-4 2/3	0	1	3	4	26	66	44	20	20.7	105.6	4	20.8	CL	A-7-6(12)
19	A	0-2/3	7	8	20	34	21	10	18	—	13.3	116.8			SM	A-2-4(0)
	B	2/3-2 1/3	17	11	32	14	5	11	18	—	11.5	122.8			SM	A-2-4(0)
	C	2 1/3-3 1/2	29	17	40	9	2	3	NL	—	13.0	122.3			SW-SM	A-1-b(0)
20	A	0-2/3	21	8	24	19	11	17	21	6	13.3	116.7			SM	A-2-4(0)
	B	2/3-3	36	7	20	19	4	14	23	7	13.1	116.9			SM-SC	A-2-4(0)
	C	3-6 2/3	35	16	27	18	1	3	NL	—	10.3	125.8			SW	A-1-a(0)
21	A	0-2/3	4	4	19	35	21	17	41	8	18.7	103.5	6	19.0	SM	A-5(1)
	B	5/6-2 1/3	23	5	20	22	12	18	25	8	12.0	118.9			SM-SC	A-2-4(0)
	C	2 1/2-4 1/6	30	11	24	15	13	7	NL	—	8.8	126.4			SM	A-1-b(0)
22	A	0-2/3	19	5	21	29	17	9	21	4	13.8	114.3			SM	A-2-4(0)
	B	5/6-2 1/3	30	9	21	20	10	10	17	—	10.7	121.2			SM-SC	A-2-4(0)
	C	3-4 2/3	9	13	51	15	6	6	NL	—	11.0	125.5	19	10.7	SW-SM	A-1-b(0)
23	A	0-2/3	1	2	9	24	39	25	47	12	22.0	97.4	6	22.6	OL	A-7-5(8)
	B	3/4-1 2/3	1	1	9	26	33	30	33	15	14.1	114.3	5	15.8	CL	A-6(7)
	C	2-3 1/2	4	6	18	38	16	18	20	5	10.5	125.3	5	11.1	SM	A-2-4(0)
24	A	0-2/3	4	5	15	40	23	13	19	3	11.3	115.6	20	10.6	SM	A-4(0)
	B	5/6-3	2	6	24	42	6	20	23	4	12.8	117.7			SM	A-2-4(0)
	C	4 1/2-5 1/6	3	2	41	49	0	5	NL	—	17.0	112.5	20	15.8	SP-SM	A-3(0)
25	A	0-2/3	0	0	8	28	31	33	33	12	18.3	104.9	3	19.6	CL	A-6(7)
	B	5/6-1 3/4	0	0	1	13	24	64	59	35	21.6	102.8	5	22.1	CH	A-7-6(20)
	C	2-3 1/2	0	0	9	32	16	43	32	14	13.8	115.0	8	13.8	CL	A-6(7)
26	A	0-1/2	0	0	12	32	24	32	55	19	26.4	87.9	7	26.5	OH	A-7-5(9)
	B	2/3-1 2/3	0	0	9	24	23	44	60	28	20.3	94.1	3	21.6	OH	A-7-5(17)
	C	2 5/6-4 2/3	0	1	9	40	22	28	18	7	10.7	125.5	3	11.2	CL-ML	A-4(3)

ACKNOWLEDGMENTS

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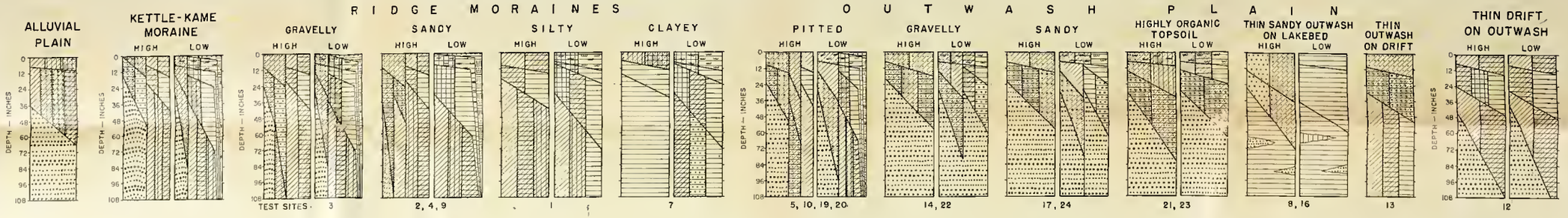
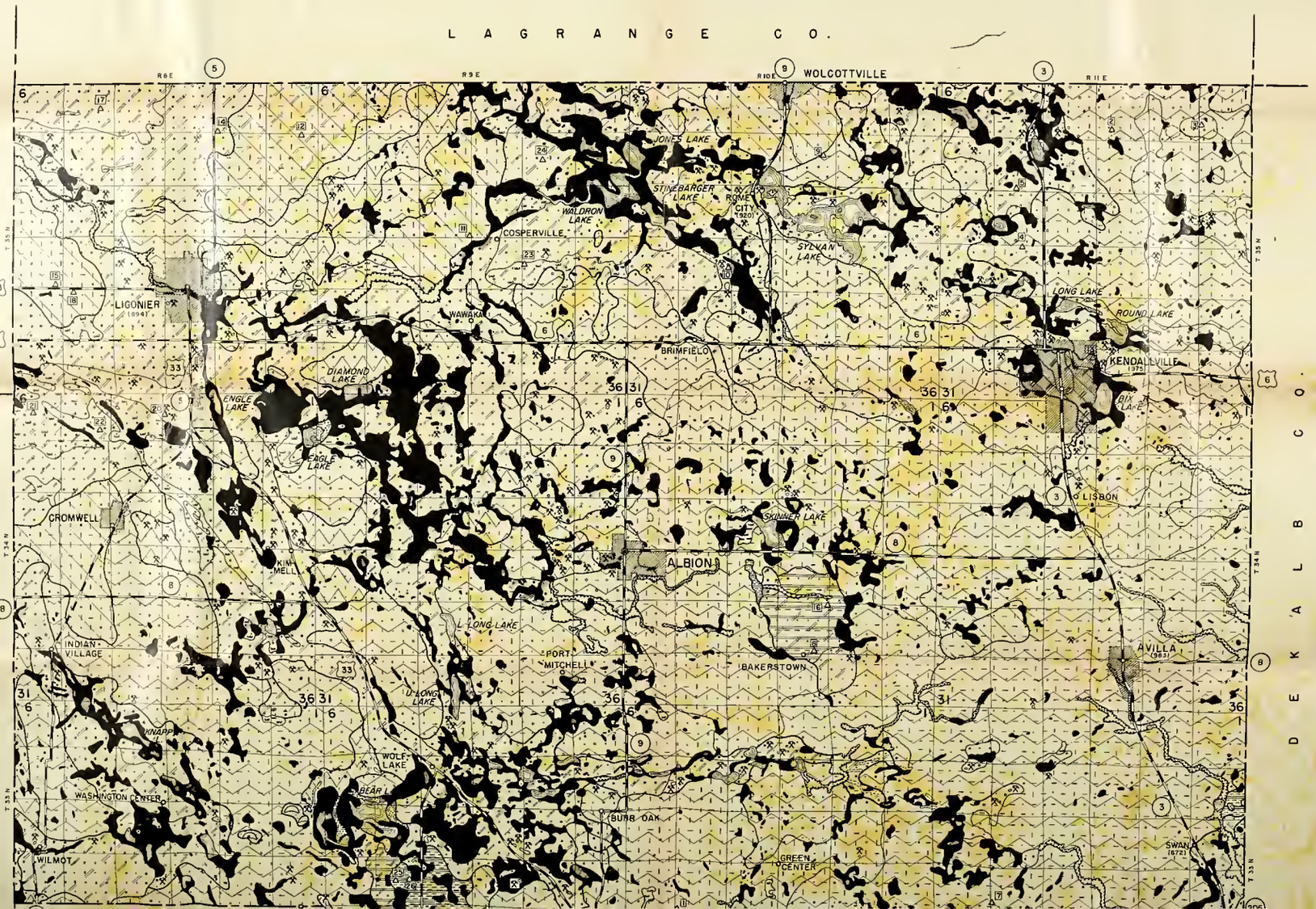
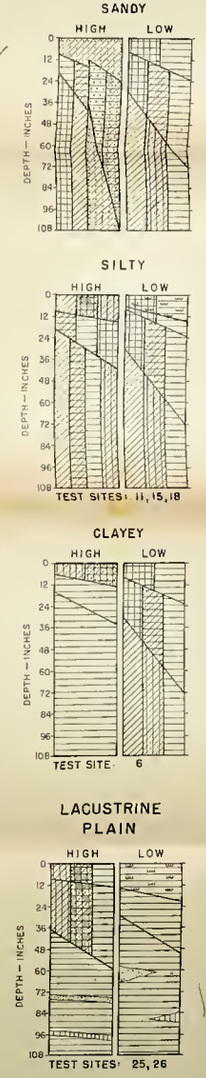
JHRP-62/27

GENERAL SOIL PROFILES

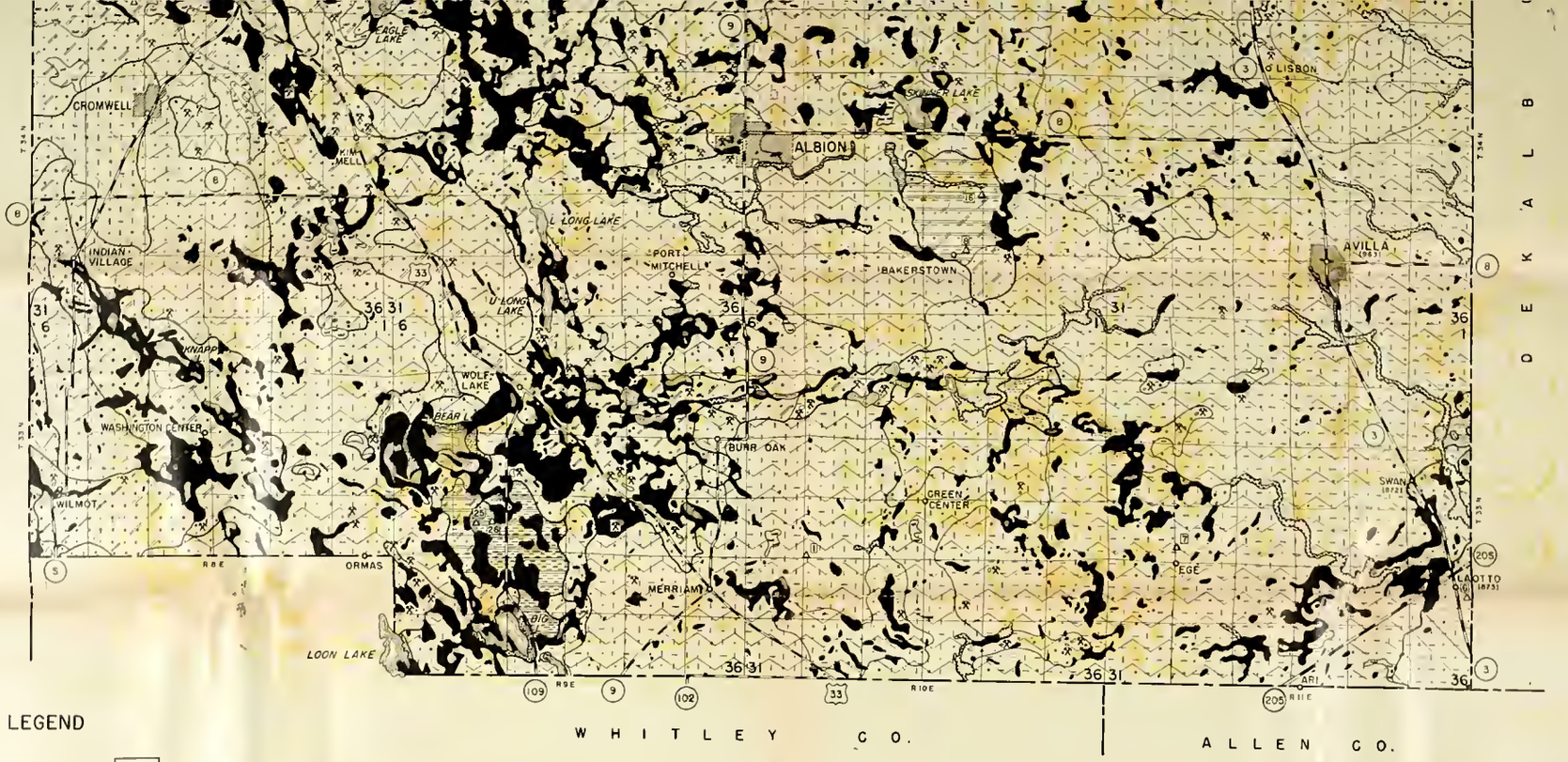


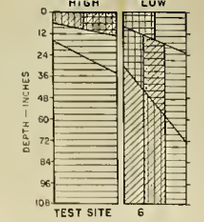


GROUND MORAINES

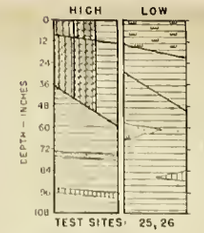


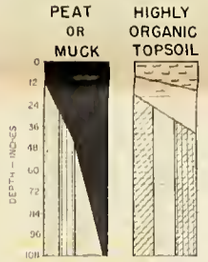
PEAT OR HIGHLY ORGANIC





LACUSTRINE PLAIN





LEGEND

PARENT MATERIALS
(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- KETTLE KAME MORAINE
- RIDGE MORAINE
- GROUND MORAINE
- OUTWASH PLAIN
- TERRACE
- LACUSTRINE PLAIN
- THIN OUTWASH ON DRIFT
- THIN OUTWASH ON LAKEBED
- THIN DRIFT ON OUTWASH
- SAND BEACH
- SAND DUNE
- ESKER
- KAME
- PEAT AND MUCK
- ALLUVIAL PLAIN

MISCELLANEOUS

- GRAVEL PIT
- LAKE AND POND
- HIGHLY ORGANIC TOPSOIL

TEXTURAL SYMBOLS
(SUPERIMPOSED ON PARENT MATERIAL SYMBOLS TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

ENGINEERING SOILS MAP
NOBLE COUNTY
INDIANA

PREPARED FROM
1938 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1962

SCALE OF MILES
1 3/4 1/2 1/4 0 1 2 3 4

SOIL CLASSIFICATION AND PROFILE SYMBOLS

Description	Grain Size Distribution: Gravel % Retained on #10	Sand % retained #10-#200	Silt % Retained 0.05-0.005mm	Clay Less than 0.005mm	Plastic Index	Symbol
Gravel	75-100	0-15	0-10	0-10	NP	
Sandy Gravel	50-75	15-50	0-10	0-10	6 Max.	
Sand	0-15	85-100	0-10	0-10	NP	
Gravelly Sand	15-47	45-85	0-10	0-10	6 Max.	
Sandy Loam	0-19	50-80	0-50	0-20	6 Max.	
Sand; Clay Loam	0-19	50-70	0-30	20-30	10 Max.	
Sandy Clay	0-19	55-70	0-15	30-45	11 Min.	
Loam	0-19	30-50	30-50	0-20	10 Max.	
Silt Loam	0-19	0-50	50-100	0-20	10 Max.	
Silty Clay Loam	0-19	0-30	70-100	20-30	11 Min.	
Silty Clay	0-19	0-15	55-70	30-45	11 Min.	
Clay Loam	0-19	20-50	50-70	20-30	11 Min.	
Clay	0-19	0-55	0-55	30-100	11 Min.	
Peat or Muck						
Organic Matter						
Top Soil						

Classification of Gravelly Soils

75%-100% gravel plus finer material - Gravel
50%-75% gravel plus finer material - Clayey, silty or sandy gravel
20%-47% gravel plus finer material - Use fine classification and called gravelly sand, gravelly silt or gravelly clay
0%-17% gravel plus finer material - Use fine classification only

PREPARED UNDER THE SUPERVISION OF P T YEH

POLYCONIC PROJECTION

DRAWN BY PETER K K HO